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# Economic & Financial Impacts of Federal Air & Water Pollution Controls on the Electric Utility Ind. Executive Summary

Temple, Barker & Sloane, Inc.

Prepared For
Environmental Protection Agency

May 1976

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EPA-230/3-76-013

# ECONOMIC AND FINANCIAL IMPACTS OF FEDERAL AIR AND WATER POLLUTION CONTROLS ON THE ELECTRIC UTILITY INDUSTRY

## EXECUTIVE SUMMARY

*prepared for*

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PLANNING & EVALUATION

*by*

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MAY 1976

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SPRINGFIELD, VA. 22161

| BIBLIOGRAPHIC DATA SHEET | 1. Report No. EPA 230/3-76-013 | 2. | 3. Recipient's Accession No. PB254307 |
|---|---|---|---|
| 4. Title and Subtitle Economic and Financial Impact of Federal Air and Water Pollution Controls on the Electric Utility Industry - Executive Summary | | | 5. Report Date May 1976 Date Issued<br>6. |
| 7. Author(s) Temple, Barker and Sloane, Incorporated | | | 8. Performing Organization Rept. No. |
| 9. Performing Organization Name and Address<br>Temple, Barker and Sloane, Incorporated<br>15 Walnut Street<br>Wellesley Hills, Massachusetts 02181 | | | 10. Project/Task/Work Unit No.<br>11. Contract/Grant No. 68/01/2803 |
| 12. Sponsoring Organization Name and Address<br>Office of Planning and Evaluation<br>Environmental Protection Agency<br>401 M Street, S.W.<br>Washington, D.C. 20460 | | | 13. Type of Report & Period Covered Final<br>14. |

15. Supplementary Notes

16. Abstracts The study focused on the determination of changes in the financial profile of the electric utility industry which are likely to result from federal air and water pollution controls for the 1975-1990 period. The analysis provides operating and financial projections at the national and regional levels as well as a detailed discussion of the financing needs and problems of the industry in the context of trends and cycles in corporate business financing. In addition, the study includes an analysis of the secondary impacts of the legislation on major industrial users of electricity. The research effort concluded that capital expenditures for plants in service will increase by $25.0 billion (1975 dollars) during the 1975-1985 period, of which $19.3 billion must be raised in the capital markets. The direct impact of the regulations upon the average residential customer's electric bill will be an increase of $2.80 per month by 1985 (1975 dollars). Assuming the industry is able to pass on the costs of pollution control equipment to its customers and offer investors a competitive return on equity (approximately 14 percent), the industry will generally be able to obtain the financing required. The study contains two parts; the first is an executive summary, bound separately; the second is a six-volume technical report which includes all methodological and analytical detail.

17. Key Words and Document Analysis. 17a. Descriptors

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

PRICES SUBJECT TO CHANGE

| 18. Availability Statement | 19. Security Class (This Report) | 21. No. of Pages |
|---|---|---|
| Release Unlimited | UNCLASSIFIED | 44 |
| | 20. Security Class (This Page) UNCLASSIFIED | 22. Price $4.00-2.25 |

# FOREWORD

This report is the result of a major program of studies sponsored by the Environmental Protection Agency as part of its continuing effort to assess the economic impacts of its regulatory programs. Unlike many of EPA's other industry economic studies where the focus is on the impact of a particular regulation, this study was aimed at examining the combined effect of all of EPA's direct regulatory programs on the electric utility industry. This was an ambitious objective and in some instances it was not possible to take every regulation into account due to the lack of data or the absence of final regulations; however, it was possible to focus quantitatively on the most significant programs, primarily those dealing with air and water pollution control.

In addition to providing an assessment of the combined impact of EPA's regulatory programs, a major objective of this study was to advance the methodologies used in previous studies so as to provide more accurate conclusions as well as provide a better foundation for future studies. This was done in many cases by making use of more up-to-date or previously unused data in areas such as industry production cost and pollution control cost. However, advances also may have been made in the basic analytical techniques used for impact analysis.

In sponsoring this study the EPA wanted to make an independent assessment of the electric utility industry. Although the overall conclusions are endorsed by the Agency, there may be instances in which technical judgments of the contractor differ from those of the EPA. Similarly, assumptions used in the study that are of a policy nature should not be construed as an indication of EPA policy intentions.

This report was prepared for EPA by Temple, Barker & Sloane, Inc. of Wellesley Hills, Massachusetts under contract number 68-01-2803. Additional copies are available through the National Technical Information Service, Springfield, Virginia 22151. Further information concerning this and other economic studies conducted by EPA can be obtained through the Office of Planning and Evaluation, U.S. Environmental Protection Agency.

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# PREFACE

This report has been submitted to the Environmental Protection Agency in fulfillment of contract No. 68-01-2803 by Temple, Barker & Sloane, Inc., 15 Walnut Street, Wellesley Hills, Massachusetts.

The research methodology employed in this study is based on a computerized Policy-Testing model (PTm) of the electric utility industry. This model is one of a series of industry models developed by Temple, Barker & Sloane, Inc. (TBS) to project the economic and financial implications of alternative policy options in the form of industry structure, rates and method of expansion, financial strategies, regulatory actions, taxation policy, economic conditions, etc. PTm(Electric Utilities) was initially developed by Drs. Howard W. Pifer and Michael L. Tennican, both of TBS, to assist the National Power Survey's Technical Advisory Committee on Finance in preparing its projections. It later served as the methodology for the Environmental Protection Agency's evaluation of the economic impact of its effluent guidelines upon the electric utility industry.

TBS wishes to express its gratitude to the many organizations and individuals who contributed to this study. The work has benefited from the cooperation of the industry's Clean Air Coordinating Committee and its predecessor, the Utility Water Act Group. The comments of the many people in EPA, other Agencies, and the industry who reviewed the earlier versions of this report have also made a substantial contribution to this final product. Particular thanks is due to our project managers at EPA, James M. Speyer and James R. Ferry, for the special efforts they also put into the study.

# THE ECONOMIC AND FINANCIAL IMPACTS OF AIR AND WATER POLLUTION CONTROLS ON THE ELECTRIC UTILITY INDUSTRY

## EXECUTIVE SUMMARY

This report presents the results of a study by Temple, Barker & Sloane, Inc. (TBS) for the U.S. Environmental Protection Agency (EPA) of the economic and financial impacts of federal environmental control regulations upon the U.S. electric utility industry. The study considers the effects of water effluent guidelines issued under the Federal Water Pollution Control Act of 1972 and of air quality regulations issued under the Clean Air Act of 1970. The analysis focuses upon the 1975-1980 and 1975-1985 time periods.

### Summary Conclusions

The study addresses the impacts of federal pollution control regulations in four respects: (1) the direct financial impacts of the regulations on the electric utility industry and its customers; (2) the effect on the ability of the investor-owned segment of the industry to finance both its basic needs and the pollution control equipment associated with the regulations; (3) the differences in impacts on utilities and consumers in different regions; and (4) the secondary impacts upon other industries, especially upon major industrial users of electricity. The major conclusions in each area are summarized below.

## Direct Financial Impacts

The major direct financial impacts upon the electric utility industry and its customers are projected to be as follows:

- Capital expenditures for plant in service will increase as a result of the regulations by $25.0 billion during the 1975-1985 period, or 10.5 percent on a base of $237.1 billion (1975 dollars).[1]
- Capital expenditures in the 1975-1980 period will increase as a result of the regulations by $14.5 billion, or 12.3 percent of the industry's baseline level of capital expenditures.
- As a result, external financing during the 1975-1985 period will increase by$21.9 billion, or 11.5 percent of the baseline projection.
- External financing during the 1975-1980 period will increase by $14.5 billion, or 16.1 percent of the baseline projection for this period.
- The combined effect upon operating revenues and average consumer charges is projected to be a 6.7 percent increase by 1985.
- The direct impact of the regulations upon the average residential customer's electric bill will be an increase of approximately $2.80 per month on an average 1985 bill of $42.40 per month.
- The direct and indirect impact of the regulations, including secondary price increases in industries dependent upon electricity, will be an increase of approximately $5.80 per month in the average residential customer's cost of goods and services, including electricity.

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[1] *All dollar figures unless otherwise noted are expressed in constant 1975 dollars.*

External Financing Impacts

The effect of federal pollution control legislation on the ability of the investor-owned segment of the industry to obtain external financing can be summarized as follows:

- External financing during the 1975-1985 period will increase for investor-owned systems by $19.3 billion, or 12.5 percent of the $155.0 billion required before consideration of pollution control equipment.

- External financing in the early part of this period (1975-1980) will increase by $13.0 billion, or 17.8 percent of a base of $73.0 billion.

- The increases in external financing amount to 1.5 percent of net household savings for the 1975-1985 period. It should be noted that the baseline financing needs of the investor-owned systems are projected to reach record levels of approximately 12.5 percent of net household savings over this same 1975-1985 period.

- Assuming the industry is able to pass on the costs of pollution control equipment to its customers and to offer investors a competitive return on equity (approximately 14 percent), the industry generally will be able to obtain the financing required both for baseline needs and for pollution control equipment.

- Under current levels of return on equity (approximately 11.5 percent) and with the present accounting treatments required by some state regulatory commissions, some utility systems may be unable to finance both their basic capacity needs and pollution control equipment in the next decade. However, the necessary financing should be available if state regulatory commissions take appropriate actions, such as allowing adequate returns on equity, changing accounting policy, etc.

- Finally, the financing outlook for pollution control is guardedly optimistic due to favorable trends in earnings and in recent regulatory decisions.

Regional Impacts

The financial impacts of federal pollution control regulations vary significantly among regions of the country, as is summarized below:

- Capital expenditures for pollution control equipment in the 1975-1985 period range from a high of $5 billion in the East North Central region[2] to a low of $0.4 billion in New England. The other regions in order of impact are: South Atlantic ($4.5), West South Central ($3.4), East South Central, ($3.4), West North Central ($2.8), Mountain ($2.5), Middle Atlantic ($2.5), and Pacific ($0.6).

- The impact in relation to baseline capital expenditures ranges from a 16.7 percent increase in the West South Central region to a 2.2 percent impact in the Pacific region.

- Based upon percentage increase in average consumer charges, which measures the relative total effect felt by customers in each region, the overall ranking from most to least affected region in the 1975-1985 period would be: Mountain (11.1 percent), East South Central (10.2), West North Central (10.1), West South Central (9.0), East North Central (8.3), South Atlantic (5.2), Middle Atlantic (4.1), New England (1.8), and Pacific (1.3).

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[2] *The geographic regions used in this research effort are the regions designated by the Bureau of the Census. See map on Page 29. Impacts were not estimated for the tenth Census region, Alaska and Hawaii, in this analysis.*

Secondary Impacts

The effects of pollution control expenditures and operations in the electric utility industry will be felt in other industries as follows:

- Generally the impacts will be very small both on major users of electricity and on other areas such as the sulfur industry.
- Product price increases in the most electricity-intensive industry, primary aluminum, would be only 1.1 percent by 1985 if all increased electricity costs due to pollution control were passed directly on in the form of increased product prices. Only three other industries would exceed 0.5 percent increases.
- In another area, the sulfur industry does not appear to be threatened by the volume of potential production of by-product sulfur from the installation of regenerable scrubbers. The likely level of by-product sulfur production by 1985 will amount to only 2.5 percent of the sulfur industry's projected volume. This 2.5 percent compares to a projected ten-year increase in industry volume of 50 to 80 percent (4 to 5 percent per year).

## BACKGROUND

Since 1971, when EPA first promulgated ambient air quality standards, each new regulation has tended to be evaluated on an individual basis. While such analyses focused attention on the issue at hand, they were often weak in two respects: first, they ignored the impact of other pollution control regulations on the industry; and second, they failed to address the effect of the changed conditions in the industry which have resulted from the Arab oil embargo and the economic slowdown of 1974-1975.

To overcome those weaknesses, the Office of Management and Budget (OMB) requested EPA to conduct comprehensive economic and financial analyses of pollution control regulations in six major industries. The electric utility industry, being a major source of at least three forms of pollution--thermal effluent discharges, sulfur dioxide emissions into the air, and suspended particulate emissions--was selected as one of the six industries to be studied.

This report presents the result of the comprehensive analysis of the electric utility industry. As requested by OMB, the report focuses upon the financial effects rather than physical or technical effects of pollution control regulations. It is designed to meet five study objectives: (1) to update and bring together in one document the assessment of the financial impact of federal pollution control regulations for both air and water; (2) to determine the industry's ability to raise the capital funds required to meet the regulations; (3) to identify the effect of the regulations upon the average residential customer; (4) to estimate the direct effects of federal pollution control regulations on different geographic regions; and (5) to determine whether there will be significant secondary effects upon the industries for which electricity costs are already a significant fraction of total costs.

With respect to the Clean Air Act of 1970, the analysis has focused upon two regulations: (1) sulfur dioxide and (2) total suspended particulates. The electric utility industry is a major emission source of both. In terms of the Federal Water Pollution Control Act, the report deals with

three types of effluent guidelines: (1) thermal effluent; (2) entrainment of organisms; and (3) chemical effluent (both 1977 and 1983 guidelines). In addition to these primary areas, which are the focus of the summary conclusions presented above, the report also discusses non-significant deterioration requirements, nitrogen oxide regulations, and pollution control equipment which is being installed for non-federal reasons (e.g., State Water Quality Standards or economic reasons, such as the lack of available cooling water).

## Baseline Projections

Even before consideration of pollution control regulations, the electric utility industry's outlook for the 1975-1985 period is similar to the last decade in that the industry will require major capital expenditures and external financing to meet the growth in demand for electrical energy. The outlook differs, however, in two important respects. First, while most projections are for somewhat lower rates of growth in demand, all projections of future demand--and therefore of required capacity additions--are much less certain than was characteristic of demand projections prior to 1974. Second, projected fuel prices are much higher and much less certain than those of the period prior to 1974.

Detailed projections of the industry's baseline conditions (i.e., conditions before consideration of pollution controls) have been developed in order to provide a basis for estimating and evaluating the financial impacts of federal pollution control regulations. The baseline projections of peak load, kilowatt-hour sales, and the

related levels of capital expenditures and external financing are summarized in the following table.[3]

SELECTED BASELINE PROJECTIONS - I
(billions 1975 dollars)

| | 1975-1980 | 1975-1985 |
|---|---|---|
| 5-Year Growth Rate in Sales (kwh) | 6.1% | 5.3% |
| 5-Year Growth Rate in Peak Load (kw) | 5.9% | 5.2% |
| Capital Expenditures (net of change in CWIP*) since 1974 | $118.3 | $237.1 |
| External Financing since 1974 | $ 89.8 | $191.2 |

*Construction Work in Progress

Source: Exhibits II-1 and II-8

The growth rates for peak load and sales, shown in the above table, were developed from published industry projections and have been reconciled against recent utility experience and the Federal Energy Administration's revised Project Independence projections (February 1976).[4] The growth rates used in this analysis are one to two percentage points below the industry's historic rate of growth of approximately 7.3 percent per year from 1960 to 1973.[5]

[3] *All tables included in the Executive Summary are excerpts from the six-volume study, The Economic and Financial Impacts of Air and Water Pollution Controls on the Electric Utility Industry. The sources listed in the tables refer to the exhibits provided at the end of each volume.*

[4] *Project Independence projections estimate a growth rate in sales of 5.7 percent (1975-1985).*

[5] *If efforts to encourage energy conservation result in even lower growth rates for peak load and total sales, then baseline capital expenditures would be lower and the impacts of pollution control regulations described later would be slightly lower in absolute terms. However, the expenses of retrofitting existing capacity would be unchanged. Thus, pollution control expenditures as a percentage of baseline capital expenditures might increase.*

Even based on the moderate sales and peak demand growth rates used in this study, TBS projects a substantial increase in capacity additions during 1975-1985. From a 1974 year-end level of 476 million kilowatts of capacity, the industry is projected to expand to 631 million kilowatts at the end of 1980 and to 751 million kilowatts at the end of 1985--an increase of almost 60 percent over the eleven-year period.

The capital expenditures projection reflects both peak demand expansion and the continuing escalation in plant costs. New coal-fired units, which in 1970 cost approximately $120 per kilowatt when they came on-stream, rose to $210 per kilowatt for units placed into service in 1975, and are projected to rise to $700 per kilowatt by 1985 (current dollars excluding AFDC[6] and pollution control. Nuclear plant costs are rising equivalently, up from approximately $150 per kilowatt for units placed into service in 1970 to $388 for those put into service in 1975 (current dollars excluding AFDC, nuclear fuel, and pollution control). Those costs are expected to continue to rise to approximately $900 per kilowatt for plants completed in 1985. The resulting projections for electric utility capital expenditures for plants placed into service (i.e., net of the change in CWIP) are $118.3 billion in the 1975-1980 period and $237.1 billion in 1975-1985, excluding AFDC.

External financing is almost a direct function of capital expenditures: $89.8 billion through 1980 and $191.2 billion through 1985. These amounts contrast with the industry's total capitalization of approximately $160 billion in 1975.

---

[6] *Allowance for Funds During Construction.*

The remaining key baseline projections which follow from the figures above are summarized in the next table.

SELECTED BASELINE PROJECTIONS - II
(1975 dollars)

| | 1975 | 1980 | 1985 |
|---|---|---|---|
| Annual Operating Revenues (billion dollars) | $51.4 | $74.0 | $96.8 |
| Average Consumer Charges (mills per kwh) | 29.6 | 31.7 | 32.0 |
| Average Residential Customer's Bill (dollars per month) | $25.60 | $34.00 | $42.40 |

Source: Exhibit II-8

As displayed above, operating revenues are projected to increase in 1975 dollars from a present annual level of approximately $51 billion to about $74 billion by 1980 and to over $96 billion by 1985. Consumer charges per kilowatt-hour, on the other hand, are expected to increase much less. The projected year-by-year pattern detailed in later exhibits shows consumer charges increasing for about three years, through 1977, and then tracking evenly with inflation (i.e., remaining virtually constant when reported in constant dollars). The 90 percent increase in operating revenues described above, therefore, is not expected to be the result of real increases in the price of electricity, but rather is a function of increased usage of electricity by customers.

The projection of the average residential customer's bill indicates this clearly. The average monthly bill is expected to increase over 30 percent from 1975 to 1980 and over 65 percent from 1975 to 1985 in real terms (i.e., in 1975 dollars). Over that entire period, however, electricity rates as described above are projected to increase by less than 7 percent in real terms. The remainder of the increase in the average monthly bill stems from increases in the usage of electricity from a 1975 level of approximately 8,155 kilowatt-hours per residential customer to a 1985 level of 12,481 kilowatt-hours.

The combined effect of the projected growth in energy usage and the projected increase in consumer charges is estimated to be an increase in the average residential bill from its 1975 level of $25.60 per month to approximately $42.40 per month in 1985. In current dollars, reflecting the effect of inflation, the average bill in 1985 will be just over $70 per month.

## Requirements of the Regulations

In order to determine the economic and financial impact of the federal regulations, EPA has attempted to estimate the amount and type of the generating capacity now in service and projected in the baseline forecast which will be affected by the federal regulations. In addition, EPA has attempted to make similar estimates of the capacity which will be affected by State Water Quality Standards and other non-federal requirements. An important concept in this analysis is the separation of pollution control equipment installed to meet federal regulations from that required by local or state regulations and from that installed because

adequate supplies of water are simply not available for once-through cooling. These estimates were made separately for each region of the country. State Implementation Plans for enforcement of the federal air regulations are taken to be direct federal requirements for controls.

## Pollution Control Equipment to be Installed

Each of the various federal regulations affects a slightly different set of electric generating plants. The sections below summarize the extent to which treatments and equipment will have to be adopted to meet the federal regulations.

First, the chemical guidelines are relatively broad in coverage compared to other regulations. It is EPA's estimate that by 1985 these guidelines will require new expenditures at approximately 40 percent of the nation's nuclear capacity and at 60 percent of the fossil capacity.

Second, the thermal and entrainment guidelines will require the installation of cooling towers on approximately one-fourth of the industry's nuclear and fossil capacity by 1985. In addition, an almost equal amount of closed-cycle cooling capacity will be built for economic reasons due to the unavailability of adequate cooling water for once-through cooling and for compliance with State Water Quality Standards, as shown in the table below.

COOLING TOWERS INSTALLED 1975-1985
(million kw)

| | Nuclear | Fossil |
|---|---|---|
| 1985 Capacity | 132.0 | 465.1 |
| Cooling Towers Installed Due to: | | |
| Economic Reasons | 34.5 | 54.8 |
| State Water Quality Standards | 1.3 | 32.3 |
| Federal Regulations* | 36.8 | 99.5 |
| TOTAL | 72.6 | 186.6 |

*Thermal and entrainment regulations, after 316(a) exemptions*

Source: Exhibit III-13

Third, the state sulfur dioxide regulations will require approximately two-thirds of the industry's coal capacity to adopt some significant change in operations by 1985 to meet the applicable emission limitation. The table below lists the four major compliance strategies and the expected degree to which each will be required. Washing and blending, which are the least expensive methods of compliance, are feasible only at plants which are very close to compliance already and therefore are expected to be used at about 11 percent of the units in service in 1985. Western low-sulfur and medium-sulfur coal are each expected to be used at approximately 21 percent of the 1985 units. Scrubbers are expected to be used on 35 percent of all coal capacity in service in 1985.

SULFUR DIOXIDE CONTROL STRATEGIES
(million kw)

| | 1980 | | 1985 | |
|---|---|---|---|---|
| Total Coal Capacity | 276.8 | | 332.9 | |
| Total Not Requiring Controls | 88.9 | (32.1%) | 74.8 | (22.5%) |
| Total Requiring $SO_2$ Controls | 187.9 | (67.9%) | 258.1 | (77.5%) |
| Strategies: | | | | |
| Washing or Blending | 32.7 | (13.4%) | 37.2 | (11.1%) |
| Western Low-Sulfur Coal | 34.0 | (12.3%) | 69.8 | (21.0%) |
| Medium-Sulfur Coal | 33.2 | (12.0%) | 33.2 | (10.0%) |
| Scrubbers | 83.5 | (30.2%) | 117.2 | (35.4%) |
| TOTAL | 187.9 | (67.9%) | 258.1 | (77.5%) |

Source: EPA and Sobotka & Co., Inc., November 1975 (see Exhibit III-9)

Fourth, the total suspended particulate regulation sets maximum emission levels for the particles in flue gases. There are two available technologies, the electrostatic precipitator and the venturi scrubber, by which to bring an out-of-compliance plant into compliance with the regulation. This analysis has assumed that all plants installing a scrubber for $SO_2$ control would incorporate a venturi scrubber if particulate control were also required. All other plants requiring controls were assumed to rely upon precipitators. Approximately 40 percent of existing plants, in EPA's judgment, will be able to meet the regulations with their current equipment. The remaining coal plants either will have to install electrostatic precipitators or upgrade their precipitators to a higher efficiency rating.

## Timing of Regulations

The heaviest impacts of the regulations will be felt in the 1977-1981 period because of the timing of the compliance schedules. The air regulations require all retrofitted units to be in compliance as soon as possible.

EPA has estimated that all retrofit should be completed before 1980. All new sources (estimated to be those plants coming on-line in 1977 and later[7]) are required to be in compliance when they are placed in service. The thermal effluent guidelines mandate compliance for existing plants by 1981, but also allow for partial exemptions and variances through 1983. The chemical guidelines require existing plants to comply with best practical technology (BPT) by 1977 and with best available technology (BAT) by 1983. New sources also are required to comply with both thermal and chemical effluent guidelines at the date they are placed into service.

As new coal plants continue to be built, significant economic effects will continue after the early 1980s as well. The baseline projections anticipate that coal-fired units will continue to account for almost 50 percent of total plant additions through 1990 and beyond, and that all will require pollution control equipment.

## Unit Costs for Pollution Control Equipment

Pollution control equipment varies substantially in cost from one type of control to another. As the table below shows, the capital costs used in this analysis range from under $2 per kilowatt for chemical effluent control to $86 for a retrofitted scrubber with a particulate venturi (in 1975 dollars).

Unfortunately, for most units there is a limited choice among the alternatives to meet a regulation. The plant, site, fuel, and regulation generally limit the choice to one or two options.

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[7] *This definition of new sources was used for analytical purposes only. The Clean Air Act requires all powerplants which commence construction after August 1971 to meet federal New Source Performance Standards.*

CAPITAL COSTS* FOR
SELECTED POLLUTION CONTROL EQUIPMENT
(1975 dollars per kw)

| | Retrofitted Units | New Units |
|---|---|---|
| Water Guidelines | | |
| Chemical Effluent Treatment (fossil) | $ 2.01 | $ 1.52 |
| Mechanical Cooling Tower (fossil) | 24.09 | 5.77 |
| Air Regulations | | |
| Scrubber | 70.27 | 55.50 |
| Scrubber with Particulate Venturi | 86.83 | 77.06 |
| Western Low Sulfur Coal with Precipitator | 62.40 | 65.88 |
| Washing and Blending | 5.40 | - |
| Precipitator | 45.50 | 56.00 |

*Estimates in table based on 1975 in-service year costs.*

Source: Air control costs: PEDCO Environmental Specialists, Inc.; water control costs: EPA

## Financial Impacts of the Regulations

Federal air and water pollution control regulations result in four major types of financial impact: (1) capital expenditures for pollution control equipment, (2) external financing for the capital expenditures program, (3) operation and maintenance expenses related to the pollution control equipment, and (4) the net effect of these costs upon operating revenues and average electric rates (consumer charges). The sections below describe each area of financial impact and conclude with a discussion of the impact of the regulations upon the average residential customer's monthly bill. In addition, one non-financial impact category, the effects upon total energy usage by the industry, is also summarized below.

## Capital Expenditures

The impact of the regulations on the industry's capital expenditures for plant placed into service (that is, net of the increase in construction-work-in-progress)[8] as mentioned earlier will be an increase of $25.0 billion in 1975 dollars during the next eleven years. That represents a 10.5 percent increase over the baseline level of capital expenditures. Almost 60 percent of that impact, $14.5 billion, will be required through 1980.

Of these impacts, the water regulations account for only 6 percent by 1980 and 20 percent by 1985. As the table below shows, the sulfur dioxide and particulate regulations account for the major capital expenditures over the decade 1975-1985, respectively 46 percent and 34 percent of the total.

CAPITAL EXPENDITURES IMPACTS
NET OF INCREASE IN CWIP
(billion 1975 dollars)

| | 1975-1980 | 1975-1985 |
|---|---|---|
| Baseline Capital Expenditures | $118.3 | $237.1 |
| Water Regulations | | |
| -Chemical | + 0.6 | + 0.9 |
| -Thermal | + 0.3 | + 3.6 |
| -Entrainment | + 0.0 | + 0.5 |
| Subtotal | +$ 0.9 | +$ 5.0 |
| Air Regulations | | |
| -Sulfur dioxide | + 8.6 | + 11.6 |
| -Particulates | + 5.0 | + 8.4 |
| Subtotal | +$ 13.6 | +$ 20.0 |
| Total Impact | +$ 14.5 | +$ 25.0 |
| % Increase from Baseline | 12.3% | 10.5% |

Source: Exhibits III-4 and III-5

[8] *"Capital expenditures" as used in this report refers to cumulative cash expenditures for plant placed into service and excludes both the increase in CWIP and the non-cash allowance for funds during construction (AFDC).*

Three types of pollution control equipment account for 91 percent of these total expenditures. Scrubbers, the most expensive per kilowatt, are projected to account for 51 percent ($12.8 billion by 1985, of which $9.8 billion is to meet $SO_2$ standards and $3.0 billion is to meet particulate standards). Precipitators and precipitator upgrades required by federal regulations will represent 24 percent ($5.9 billion). Cooling towers will account for the remaining 16 percent ($4.1 billion).

Included in these costs are allocated costs for replacement generating capacity to make up any energy requirement and unit derating caused by the pollution control equipment. The total which is attributable to replacement capacity is $4.0 billion in the 1975-1985 period. Scrubbers will account for $2.1 billion of that, cooling towers for $1.7 billion, and all other equipment for the remaining $0.2 billion.

External Financing

These capital expenditure requirements will necessitate a significant amount of financing by the utilities in the nation's debt and equity markets. In fact, total external financing impacts are almost equal to the amount of the capital expenditures impacts for three reasons: (1) the definition of capital expenditures for this analysis refers to cash outlays only, excluding AFDC; (2) the same convention also excludes CWIP increases from what is reported as capital expenditures impacts, but those increases must still be financed in the capital markets; and (3) the industry's internal sources of funds already are allocated to baseline capital projects and generally are not available for incremental investments in pollution control facilities. The impact on external financing is $14.5 billion by 1980 and $21.9 billion in the full 1975-

1985 period. Those amounts represent increases above the baseline financing levels for the industry of 17.8 percent by 1980 and 12.5 percent by 1985. The industry's financing needs are so important that an entire volume of the report, Volume IV, is devoted to capital availability. Its conclusions are also summarized in a later section of this Executive Summary.

### Operating and Maintenance Expenses

The increases in operating and maintenance expenses in relation to the baseline projections are estimated to be 6.0 percent in 1985. That increase covers the operating costs of the pollution control equipment, including the premium, if any, paid for low-sulfur fuel used to meet the regulations. The total increase in operating and maintenance expenses is projected to be $1.8 billion per year by 1980 and $3.2 billion per year by 1985. The water regulations account for $0.5 billion of that latter number, while the air regulations account for $2.7 billion.

### Operating Revenues and Consumer Charges

The total cost to consumers of pollution control in the electric utility industry is represented by the additional revenues collected from consumers to cover pollution control capital and operating costs. The total premium paid by consumers because of federal pollution control regulations is projected to be $3.9 billion in 1980 and $6.5 billion in 1985. The air regulations account for the majority of the cost, $3.4 billion in 1980; the water regulations account for the remaining $0.5 billion. The air and water proportions in 1985 are $5.3 and $1.2 billion, respectively. Over the entire period 1975-1985 the cumulative cost to consumers of federal pollution controls on this industry will be $40.2 billion.

The average increase in costs to consumers will be approximately 5.3 percent in 1980 and 6.7 percent by 1985. On a kilowatt-hour basis the cost of the average consumer charge will increase by approximately 1.7 mills by 1980 on a base charge of 31.7 mills per kilowatt-hour. Of this 1980 impact, the air regulations account for 1.5 mills, the water regulations for 0.2 mills. By 1985, the average consumer charge will increase 2.1 mills per kilowatt-hour on a base of 32.0 mills. The air and water regulations account for 1.7 and 0.4 mills, respectively, of the 1985 total. The table below illustrates this change.

**AVERAGE CONSUMER CHARGES**
**(mills/kwh - 1975 dollars)**

| | 1980 | 1985 |
|---|---|---|
| Baseline | 31.7 | 32.0 |
| Impact of Air & Water Regulations | 1.7 (5.3%) | 2.1 (6.7%) |
| Total | 33.4 | 34.1 |

To view these costs in perspective it is useful to relate them to the average monthly bill paid by residential customers. The average bill is projected to increase even in the absence of pollution control impacts at a real growth of approximately 5 percent per year, from $25.60 per month in 1975 to $42.40 per month in 1985, reflecting a continuing growth in electricity usage per customer. In current dollars the bill is estimated to be $70.80 in 1985.

The direct increase in an average residential electric bill as a result of the federal pollution control regulations will be approximately $1.80 per month in 1980 and $2.80 per month in 1985. In relative terms, those impacts represent 5.3 percent and 6.7 percent increases.

Another important measure of pollution control costs is the combined direct and indirect increase in the monthly bill, that is, the total cost of pollution control allocated just over residential customers' usage. The assumption in using this measure is that all impacts which are charged first to industries are ultimately passed on to residential customers in the form of price increases on their products and services. Under that assumption, the direct and indirect increase in the average residential customer's total costs will be approximately $4 by 1980 and $5.80 by 1985. These dollar amounts represent 5.3 and 6.7 percent increases in the direct and indirect costs of electricity to consumers in the respective years.

Energy Impacts

The capacity deratings and the energy required to operate pollution control equipment will require the addition of 4.3 million kilowatts of capacity by 1980 and a total of 9.2 million kilowatts by 1985. That level of additions represents approximately a 1 percent increase in the industry's total capacity.

The energy penalty resulting from pollution control equipment will be 0.2 quads (quadrillion Btu) in 1980 and 0.5 quads in 1985. The industry's total energy consumption under the baseline conditions is projected to be 25.8 and 33.2 in the same years. Consequently, the energy penalty is approximately 1.5 percent in 1985. Energy penalties by strategy for nuclear and fossil units are illustrated below. It should be noted that these estimates do not include indirect energy impacts such as energy to mine limestone for scrubbers or increased fuel consumption to move Western low-sulfur coal to eastern markets.

CAPACITY LOSSES AND ENERGY PENALTIES
FOR FOSSIL AND NUCLEAR UNITS AFFECTED
BY AIR AND WATER REGULATIONS

| | 1980 | 1985 |
|---|---|---|
| Total Industry Capacity (million kw) | 631.0 | 751.1 |
| Capacity Losses Since 1974 (million kw) | | |
| Fossil | | |
| Scrubbers | 3.3 | 4.6 |
| Western Low-Sulfur Coal | .2 | .2 |
| Precipitators | .3 | .3 |
| Cooling Towers | .4 | 3.0 |
| SUBTOTAL | 4.2 | 8.1 |
| Nuclear | | |
| Cooling Towers | .1 | 1.1 |
| TOTAL | 4.3 | 9.2 |
| Total Industry Energy (quads*) | 25.8 | 33.2 |
| Energy Penalties (quads*) | | |
| Fossil | | |
| Scrubbers | 0.2 | 0.3 |
| Precipitators | 0.0 | 0.0 |
| Cooling Towers | 0.0 | 0.2** |
| SUBTOTAL | 0.2 | 0.4 |
| Nuclear | | |
| Cooling Towers | 0.0 | 0.1** |
| TOTAL | 0.2 | 0.5 |

*Quadrillion Btu*

**Cooling Towers - Energy Penalties have been rounded; actual detail is as follows: Fossil = 0.15; Nuclear = 0.05*

Note: Values listed as "0.0" are too small to show at this level of detail.

Source: Exhibit III-2

## Financing Pollution Control

The electric utility industry's pollution control equipment financing requirements represent a 12.5 percent increase over the industry's 1975-1985 baseline needs, which are themselves projected to be at record levels. Moreover, the industry's requirements are likely to be a large and increasing fraction of the total supply of funds available to all sectors of the economy, so that investors' perceptions

of the financial health of the industry and its constituent firms is crucial to the industry's success in meeting its total requirements. The report's conclusions on the above topics are summarized below.

## The Industry's Financing Requirements

The electric utility industry will need external financing of approximately $191.2 billion (1975 dollars) from 1975 to 1985 before consideration of federal pollution control regulations. Of this total, $155.0 billion is required by investor-owned utilities; the remaining $36.2 billion represents the needs of the public segment of the industry. The private industry's financing requirements are approximately $12.2 billion per year from 1975 to 1980 and $16.4 billion per year from 1981 to 1985.

The total industry's 1975-1985 financing needs will be increased by $21.9 billion (from $191.2 to $213.1 billion) by federal pollution control legislation. Investor-owned companies are responsible for $19.3 billion (88.1 percent) of the incremental financing need and for $174.3 billion (82 percent) of the need for both baseline and pollution control financing. These private financing requirements average about $2.2 billion per year from 1975 to 1980 and $1.3 billion per year from 1981 to 1985, reflecting the profile of expenditures for retrofitting existing plant capacity.

## Electric Utilities' Needs vs. the Total Supply of Funds

The electric utility industry's future external financing needs will be significantly above historical levels relative to the probable amounts of other corporate financing

and of total U.S. sources and uses of funds. Assuming that household savings in the future continue to be at their historical average of 6 percent of GNP and assuming that the real growth rate in GNP is 3.5 percent, the industry's future net external financing needs will increase from an historical high of 11.5 percent of household net savings in the 1970-1974 credit cycle to a level of 12.5 percent in the 1975-1985 period even before consideration of pollution control expenditures. Pollution control financing is projected to raise the industry's requirements to 14 percent of net household savings. Nonetheless, as is briefly reviewed below, assuming the industry is able to pass on the costs of pollution control equipment to its customers and to offer investors a competitive return on equity (approximately 14 percent), the industry generally will be able to obtain the financing required both for baseline needs and for pollution control equipment.

## The Industry's Position in the Competition for Funds

Some observers have predicted that electric utilities will be attempting to meet their financing needs in very tight overall capital market conditions, but this difficult prospect seems unlikely, at least through 1980. In these projections, the financing needs of all non-financial corporations may be as high as 83 percent of net household savings. And, if total corporate financing needs are that high, utilities will be competing for record levels of funds in extraordinarily tight capital markets. However, the extremely high levels of total corporate financing needs envisoned in this scenario are not very likely to occur. And, even in the event of tight capital markets, it is within the

power of state regulatory commissions to grant price increases sufficient to enable utilities to "crowd out" many weaker corporate borrowers.

Under more probable projections of total corporate financing needs, capital market conditions will be less tight, but the electric utility industry's financing needs will still be difficult to meet unless the industry's interest coverage ratios and returns on common equity continue to improve relative to the 1974-1975 levels. If total corporate financing needs are equal to about 63 percent of net household savings--a level which compares with a 65 percent share in the last credit cycle and a 58 percent share in the 1967-1970 credit cycle--capital market conditions will be moderately tight. The electric utility industry's financing needs before consideration of pollution control will represent 20 percent of total corporate financing. The industry's share including its pollution control financing needs will rise to 22 percent of the total. These shares compare with a record-high level of 18 percent in the most recent credit cycle. However, a modest increase in the current financial health of the electric utility industry should enable it to compete successfully for the amounts of funds required in the 1975-1985 period.

If total non-financial corporate demand for financing is lower than the levels of the most recent credit cycle, as is likely, future capital market conditions will be relatively easy. If so, however, the electric utility industry's share of total corporate financing will be well above the peak historical level of 18 percent. Before consideration of pollution control financing, the industry's needs will rise to 32 percent of the corporate sector's total. With pollution control financing, the industry's

share will rise to 36 percent. Such shares are possible, but only if utilities have very strong financial statistics. Unless regulators allow returns on common equity and interest coverage ratios that enable the electric utility industry to regain its status of the 1960s as a low-risk industry, investors may be very unwilling to commit as much as a third of their corporate investment portfolio to the industry.

## Possible Problems of Individual Firms

Even if adequate sources of funds are available for the industry as a whole and even if the industry's financial strength is, on average, adequate to enable it to compete effectively for these funds, some firms may still have difficulty in obtaining capital. The industry average ratios have historically been the aggregate of individual company ratios which vary widely. Therefore, even when the industry's average rate of return on equity has been equal to the rate of return demanded by investors, a number of firms have had lower returns on equity and interest coverage ratios that have severely hampered their access to external financing. Therefore, the special problems of individual firms are of importance. In recent years, these problems have sometimes been severe. In fact, some firms are currently unable to finance desired basic capacity additions except through methods, such as the issuance of stock at prices less than book value, that are costly and perhaps unsustainable in the long run.

Individual electric utilities may be able to improve their financial health by further improvements in efficiency and by reductions in service, but the resolution of the financing difficulties faced currently by a number of utilities depends essentially on the decisions of state regulatory commissions. Pollution control revenue bonds and reductions in

debt ratios have been advanced as solutions for the interest coverage problems facing some companies, but TBS's judgment is that neither will substantially alleviate these companies' financing difficulties. Moreover, the first alternative will not help and the second alternative may hurt these companies' efforts to issue common stock at reasonable prices. Thus, the basic requirement for returning ailing companies to financial health is an increase in revenues, which increase it is within the power of regulatory commissions to create.

In many instances, the price increase required to restore individual companies to financial health is simply the relatively small increase required to bring returns on equity to levels demanded in the marketplace by investors. In some instances, however, the increases may take a form different from, or in addition to, the increases associated with an adequate return on equity. The increases may, for example, be those associated with a conversion from flow-through accounting to normalized accounting or with the inclusion of construction work in progress in a utility's rate base.

Recent Trends

Fortunately, recent trends in the capital markets and in regulation provide a basis for some optimism concerning the electric utility industry's ability to meet its external financing needs. Although a number of considerations (such as GNP growth rates, net household savings rates, the financing needs of other corporations and other sectors, etc.) are relevant, the basic determinant of the industry's access to funds is the level of its allowed return on common equity relative to the rates of return required in the capital markets. The basis for optimism is twofold. First, a number of recent regulatory decisions have allowed rates of return well

above historical levels. Second, as rates of inflation have abated, the returns on investments comparable in risk to utility securities have declined. As as result, the industry's interest coverage ratios and common stock prices have been improving significantly in recent months. In early 1976, for example, a sample of 40 large electric utilities had common stock prices averaging 99 percent of book value. This compares with a 1974 value of 52 percent for Moody's Public Utility Index (based on 24 electric utility systems).

## Regional Impacts

The nine census regions will be affected differently by the implementation of the air and water pollution control regulations. (See map on the following page.) The differences are primarily due to the amount of generating capacity which falls under the purview of the regulations. The differences in financial impact can best be established by displaying the differences among regions in additional capital expenditures and consumer required charges by 1985.

The $25 billion impact in capital expenditures at the national level is dispersed across regions in amounts varying from a high of $5 billion in the East North Central region to a low of $0.5 billion in New England. Between these extremes, the remaining regions will require additional capital expenditures in the following order: South Atlantic ($4.5), West South Central ($3.4), East South Central, ($3.4), West North Central ($2.8), Mountain ($2.5), Middle Atlantic ($2.5), and Pacific ($0.6).

While the absolute amount of capital expenditures needed in some regions is relatively high, that amount may not represent as significant a percentage increase in the

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total capital outlays as may be the case in some regions starting out from a small base. The average change in additional capital expenditures as a percent of baseline capital expenditures (without pollution control) is 10.5 percent. The range among regions is 2.2 percent (Pacific) to 16.7 percent (West South Central). Among the other regions, three are above the national average (Mountain, East South Central, and East North Central) and four are below (West South Central, South Atlantic, Middle Atlantic and New England). Therefore the degree of the impact varies depending upon whether the focus is on absolute capital requirements or on the magnitude of the change from a base level.

The same relationship exists regarding the degree of impact where consumer charges are used as a measure. The regions with the largest changes do not necessarily have the highest total consumer charges. The range of increases in consumer charges attributable to pollution control is 1.3 to 11.1 percent in 1985, while the national average is 6.7 percent. On that basis, the regions will be affected as follows: Mountain (11.1), East South Central (10.2), West North Central (10.1), West South Central (9.0), East North Central (8.3), South Atlantic (5.2), Middle Atlantic (4.1), New England (1.8), and Pacific (1.3).

The regional analysis has identified four key factors which account for the differences in impacts among regions: (1) the amount of coal capacity in the region; (2) the amount of capacity affected by the air regulations or the water regulations or both; (3) the pollution control technology chosen to comply with each regulation; and (4) the usage of electricity per customer which reflects, among other things, the variations in the use of electrical heating instead of oil or gas.

## Secondary Impacts

The overall conclusion of this analysis is that secondary economic impacts of pollution control equipment in the electric utility industry will be very small on major users of electricity and on other areas such as the sulfur industry.

### Major Users

Secondary economic impacts on major users of electricity will be small by any measure. In the primary aluminum industry--the most electricity-intensive industry and the one where the impact will be greatest--higher costs for electricity brought about by utility expenditures for pollution control equipment will cause an increase in product price of 1.1 percent by 1975 (assuming an otherwise unchanged industry return on investment). The increase will exceed 0.5 percent in only four of the ten most electricity-intensive industries. The average for all industries will be less than 0.1 percent. In addition, these figures are based on conservation assumptions which may overstate the effects. In any event, when experienced over a ten-year period, even the 1.1 percent increase projected for primary alumimum prices appears quite modest in comparison with the 30 percent price increase that occurred between 1971 and 1974 (and the even larger increase since 1974).

### Other Areas

The sulfur industry is the area most likely to be affected as utilities install pollution control equipment. However, the production of by-product sulfuric acid from regenerable scrubbers is likely to be only about 2.5 percent

of industry production by 1985. An addition of that size--in an industry expected to grow at a 4 to 5 percent annual rate over the next decade--is unlikely to have major consequences for product prices or existing sulfur producers. In a similar fashion, as electric utilities install pollution control equipment, the economic impact on other areas will be small. Those industries producing pollution control equipment will of course be stimulated by the expenditure of $25 billion (1975 dollars) between 1975 and 1985. Purchases of limestone will be increased but are not expected to seriously affect limestone markets. Employment impacts will be mixed: jobs will increase for the construction and installation of pollution control equipment--40,000 to 50,000 construction jobs annually. On the other hand, price increases in the electric utility industry and other industries may reduce demand from what it would otherwise be, so that total employment in these industries may grow at a slightly slower rate because of environmental regulations. Consequently, there will be little if any net change in employment overall.

Although there will be increased costs for electricity passed on to commercial and industrial customers, those increases will not cause significant changes in the economic structure of any individual industry. In fact, the impacts are sufficiently small even in the most electricity-intensive industry that one can conclude that the overall effects of the pollution control expenditures will be diffused broadly throughout the entire economy.